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Demo: Sound localization using smartphone

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Demo: Sound Localization using Smartphone *

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1. INTRODUCTION

Smartphones based sound direction estimation can be helpful in many situations. For example, a deaf person in a meeting room can look at the smartphone to find out which direction the speaker is in and then he can look in appropriate direction to read lips/gestures of the speaker.

Many smartphones today come with two built-in microphones located at physically different positions. This difference in position can cause time difference of arrival (TDOA) of sound on both microphones. Value of TDOA for two microphones may vary depending on the location of sound source with respect to the smartphone. This time difference of arrival can be used to estimate incoming sound direction with respect to smartphone.

Challenges involved in angle estimation arise mainly because of heterogeneous characteristics of different types of sounds, small distance between two microphones on the smartphone and different positions of microphones on different devices. In this work we implemented TDOA based angle estimation for white noise as sound source. We look at this work as a first step towards achieving application described earlier.

TDOA based techniques have been used before for angle estimation as described by Murray et.al in [**?**]. Their work however requires dedicated hardware and hence need some preparatory setup. More than two microphones have also been used for angle estimation as described in [**?**]. This technique involved using 6 microphones placed at different heights.

Our approach uses a commodity smartphone and requires no preparatory setup. We don't use any signal processing and there are no requirements for internet connectivity. Application computes TDOA using signal cross-correlation and then maps the TDOA to appropriate angle. Angle is measure anti-clockwise with respect to the camcorder of the smartphone.

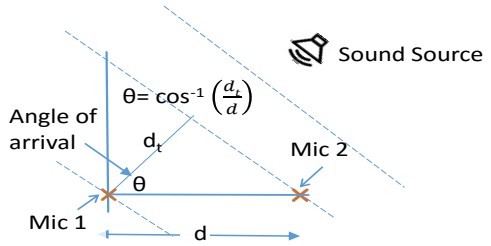

Figure 1: Angle of Arrival Derivation from Time difference

Figure 1 shows angle derivation for a given value of time delay. Sound source lies in first quadrant and d_t is difference in distance traveled by sound to reach both microphones and d is distance between two microphones of the smartphone.

If the line connecting both microphones is assumed as x-axis then using our technique, we could localize user in 0 to 180 degree horizontal plane with respect to the phone.

In our experiments, we estimated 9 different angles (0^o, 20^o, 40^o, 60^o, 90^o, 120^o, 140^o, 160^o and 180^o). Results of estimation reflects that this TDOA based approach can work for white noise with a maximum estimation error of 3^o and a estimation delay of less than 1 second.

2. DEMONSTRATION

We will demonstrate our Android application using Samsung Galaxy S3 smartphone and white noise as the sound source. We will place the sound source at 1 meter distance from the smartphone and play the sound. Then we move the sound source in 180 degree horizontal plane and show the angle estimated by the system.

3. REFERENCES

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